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The Cortisol Response to Awakening: A Potential Biomarker for Occupational Stress

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Workplace stress may result in adverse health outcomes through its effect on the function of the Hypothalamic-Pituitary-Adrenal (HPA) axis. The cortisol response to awakening has recently been shown to be a useful marker for evaluation of HPA function. The normal cortisol response to awakening is a brisk increase in cortisol by about 30 minutes after awakening, followed by a decline to baseline within 60 minutes. However, in some individuals, perhaps 20 percent of the population, there is no increase in cortisol upon awakening. This “flat” pattern indicates lack of responsiveness, or dysfunction, of the HPA axis. HPA axis dysfunction, assessed by changes in the diurnal pattern of cortisol production, has been shown to be associated with a wide range of chronic conditions including metabolic syndrome, depression, and autoimmune disorders. The literature examining the cortisol response to awakening as a measure of HPA function is new, and relatively few studies have been published. No studies have shown how a person’s early morning cortisol response might change over time from “normal” to “flat.” However, stress may be a factor in this process. Subjects reporting chronic stress show abnormalities in the cortisol response to awakening: response patterns include increases in cortisol, delays in the timing of the peak cortisol value, and, in subjects experiencing “burnout,” decreases in cortisol production.

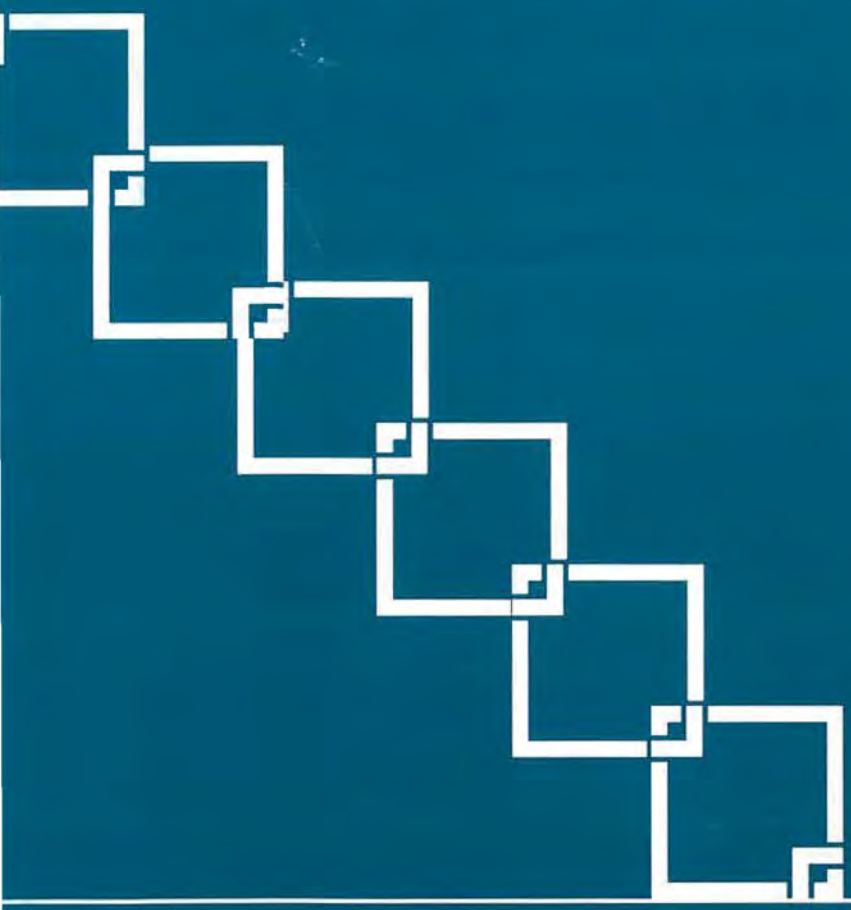
In preparation for using the cortisol response to awakening for a study of workplace stress among coal miners, we conducted a pilot study among 23 male NIOSH employees, aged 40-54 (the age and gender distribution of the planned mining study). The study was designed to compare the response of cortisol on early morning awakening to the response to a protein load, which had been previously reported to be a reliable stimulus for cortisol production by the HPA axis. Each subject obtained 10 saliva samples for analysis of cortisol levels using a commercial collection device (Salivette). The first five samples were obtained at 15 minute intervals beginning with time of awakening. The sixth sample was obtained at noon, at which time subjects drank a commercial high protein drink containing 55 gms of protein (Pro Complex). The last four samples were collected at 15 minute intervals following ingestion of the protein drink. Subjects recorded their stress level on a visual analog scale each time they obtained a saliva sample. The patterns of cortisol response to awakening were divided into three groups: 1) Normal (8 subjects) 2) Flat (2 subjects) and 3) Downsloping (12 subjects). One subject with an otherwise normal pattern was excluded from analysis because of an unusual spike in cortisol at 60 minutes. Among subjects with normal profiles, there was a high and consistent correlation between the reported stress level and the cortisol level for all the awakening samples, and for the first two samples obtained after ingestion of the protein drink. (Range of $r = -.67$ to $-.79$, p -value range $.02$ -. 07). Among subjects with downsloping profiles, no consistent pattern was detectable. We conclude that a downsloping profile of cortisol response to awakening, not reported previously in the literature, may indicate poor responsiveness of the HPA axis to stress. This pattern may be intermediate between the “normal” profile and the “flat” profile. Further research is needed to determine how chronic stress may contribute to changes in HPA responsiveness, assessed by the cortisol response to awakening.

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